WORLD MAPS OF CONSTANT B, L, AND FLUX CONTOURS

by
E. G. Stassinopoulos
Goddard Space Flight Center

INTRODUCTION

The B and L contours presented with this paper are updated versions of similar ones published in 1965 by Roederer et al. (Reference 1). In many instances the B and L contours are used to study the trapped radiation environment. In order to facilitate this work, a set of comprehensive flux maps has been added to the series.* This arrangement is functional and facilitates the correlation of the material.

A total of 31 maps for each parameter, B and L, has been produced for successive altitudes 100 km apart, ranging from the earth's surface to 3000 km above sea level. The flux contours completed at the time of this writing are also presented in steps of 100 km and extend only from 100 to 1000 km above the oblate geoid; they are constructed separately for protons and electrons and are represented in sets of six integral energy thresholds per altitude. No differential energy fluxes were included in this effort because past requests and inquiries have been exclusively oriented towards integral flux values. If the scientific and engineering community indicates sufficient interest in differential maps, these may be added to the next updated version of this work, to be issued in about a year. Furthermore, because the environment models were produced from integral and broad band energy measurements, no great accuracy can be assigned to the spatial distribution of a differential band.

The minimum-B equator is calculated with a program developed for another study. In all maps, the continents are indicated by grey shading, and maps depicting surface projections of some typical circular orbits have been included.

METHOD

Map Generation

For a given altitude level, a grid is generated with constant intervals of two degrees in latitude and three degrees in longitude. At the grid points, the magnetic parameters B and L, and the instantaneous electron and proton fluxes for the given integral energies, are calculated and stored.

The location of the desired B or L contours is then determined latitudinally by an exponential, and azimuthally by a linear interpolation. The obtained positions are cross-correlated and the matrix elements are ordered into plotting vectors, or arrays, from which the curves are drawn by computer.

*These flux maps were proposed by Stassinopoulos in 1967 (Reference 2), and were initially intended as a supplement to Part 2 of Reference 2.

A similar procedure is employed for the construction of the J maps, but only after the environmental spectra have been applied to the positional fluxes at the grid points and the resulting J-values at the following cut-off energies have been stored:

Electrons	Protons
E > 0 MeV	E > 3 MeV
.5 MeV	5 MeV
1 MeV	15 MeV
3 MeV	30 MeV
5 MeV	50 MeV
7 MeV	100 MeV

B, L, and Flux Calculations

The magnetic field strength, B, is calculated with McIlwain's latest MAGNET subroutine employing the 99-term geomagnetic field model by Hendricks and Cain for the epoch 1960.0, projected to 1965.0 (Reference 3). The L-parameter is computed with Hassit and McIlwain's new INVAR subroutine (Reference 4).

Flux calculations are based on Vette's composite environment models: the AE2 for electrons (Reference 5), and the AP1-AP4 for protons (Reference 6). Starting with the geocentric coordinates of the grid points, the magnetic parameters are computed and the fluxes are then calculated as functions of these parameters.

Minimum-B Equator

The B_{min}-equator is obtained through field line tracing with the LINTRA program (Reference 7), especially modified for this purpose. An iterative scheme is employed whereby line-of-force arcs are traced about the magnetic dipole equator and the positions of their B_{min} values are located in geocentric coordinates; the process is continued for higher or lower lines until the specified altitude has been reached.

The repeated application of this procedure for starting points, incremented appropriately in latitude and longitude, yields the global equatorial intersect at a fixed constant height.
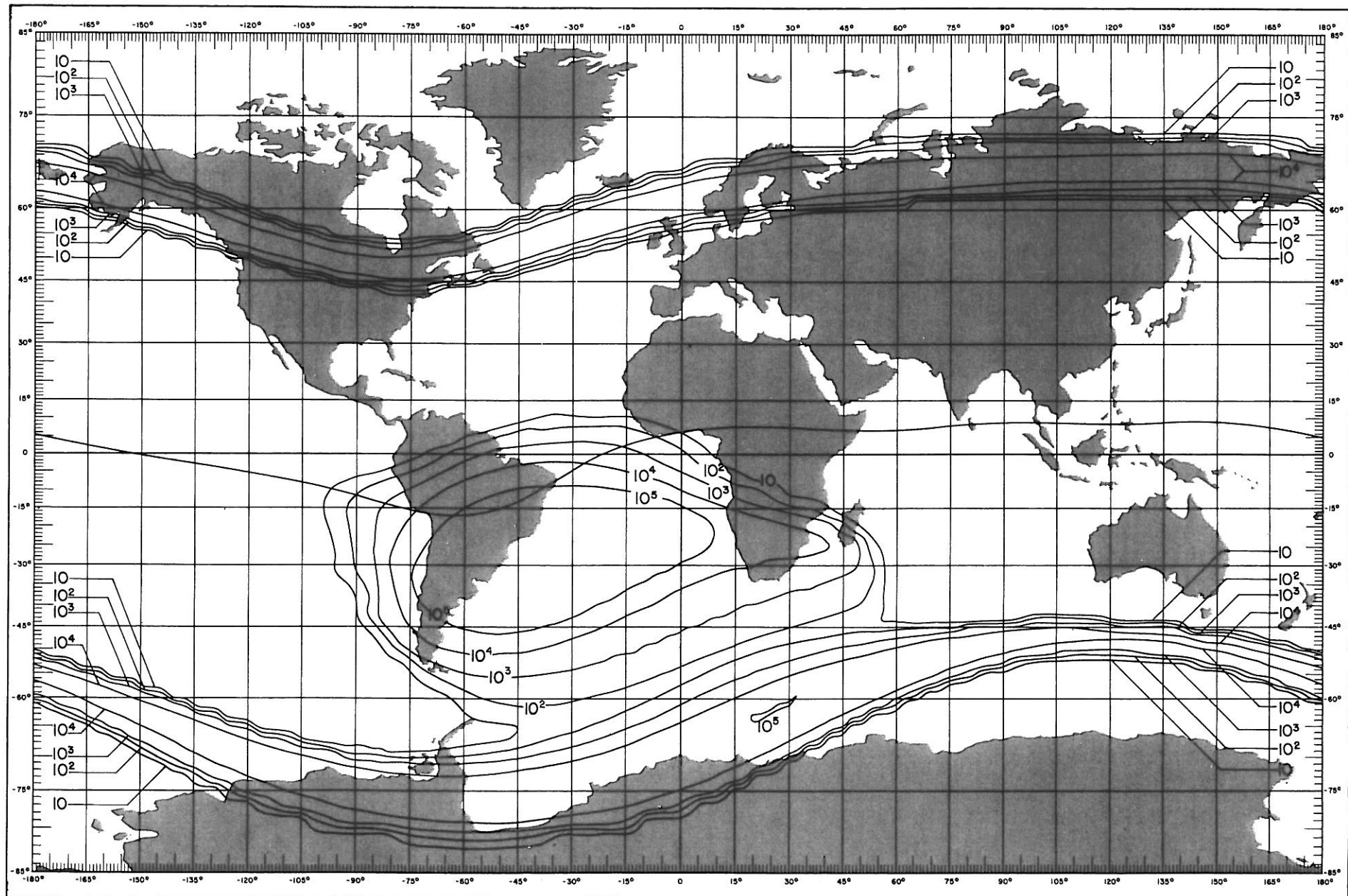
RESULTS

All contours are plotted on a Miller Cylindrical Projection. Improvements in the models, the codes, and the plotting techniques have greatly increased the accuracy of these maps over those previously published. The error in the location of the B and L curves does not exceed ±1 degree in longitude or ±.5 degree

PROTON FLUX CONTOURS—E > 3 MEV.

ALTITUDE = 600 KM

82
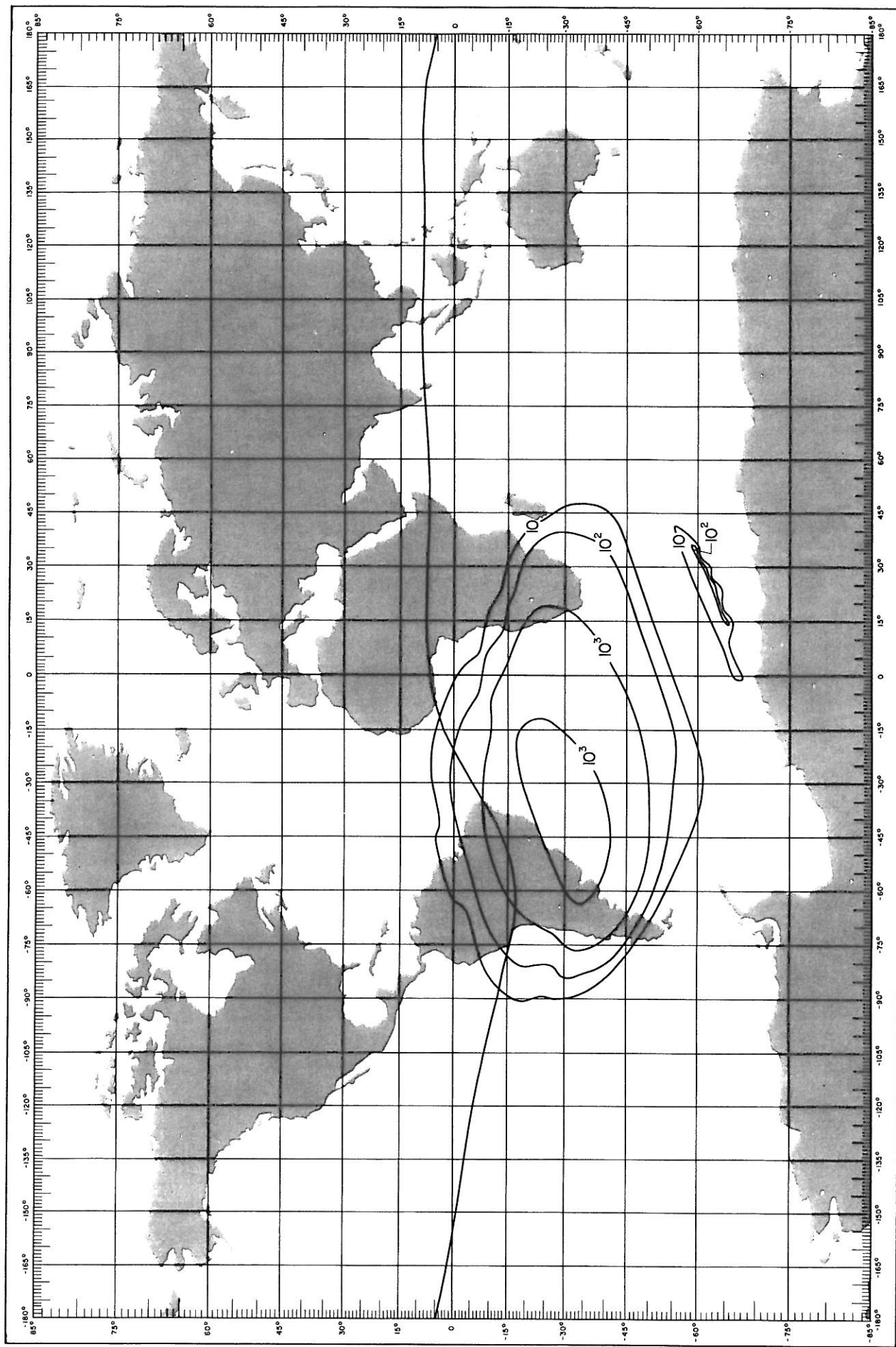
ELECTRON FLUX CONTOURS—E > 1 MEV

ALTITUDE = 600 KM